

by an Austrian botanist and geologist from whose studies much new information is expected.

ONE of the interesting minor results of M. Dybowski's recent journey from the Mobangi to the Shari was the discovery that the natives of that part of the Sudan use chloride of potassium instead of chloride of sodium to season their food. They carefully select plants which on burning yield an ash containing a minimum of carbonates, and extract their "salt" by boiling water, subsequently filtering and evaporating the solution.

DR. A. GLOY has recently published a very interesting discussion of the population of Schleswig-Holstein, tracing its distribution to the character of the land. In order to represent graphically the cause and effect on the same paper, the various agglomerations of people from single cottages to towns of over 2000 inhabitants, are shown by dots of increasing size on a geological map. It thus becomes apparent that the population is arranged so that the fertile fenlands and clay ridges which run from north to south are relatively thickly peopled, while the belt of sandy and barren soil separating them has few houses except along its boundaries. The type of dwelling in rural villages is also found to vary, showing a clear relation to the former extension of the Slav tribes westward before the time of Teutonic predominance.

In a careful study of the political divisions of the earth, Dr. A. Oppel has come to the conclusion that about 1,700,000 square miles are uninhabited or ownerless, about 5,000,000 square miles more without settled government, and the remaining 45,000,000 square miles are occupied by definite states. He recognises seventy-five such states, but most of them are of such insignificant superficial extent that the eighteen largest make up 87 per cent. of the whole area.

FLIES AND DISEASE GERMS.

AS we become more intimately acquainted with the nature of pathogenic micro-organisms, the manner in which their distribution takes place also becomes more intelligible. For several years past, through researches made by Grassi, Cattani, and Tizzoni, it has been known that flies are capable of disseminating cholera bacteria. These authors placed minute quantities of these bacilli on to the bodies of flies and found that after carefully preserving them under a glass shade in diffused daylight for an hour and a half and longer, when introduced into sterile culture media these flies gave rise to typical cholera growths. These results have quite recently been confirmed by Simmonds. Further experiments on the part played by flies in the propagation of disease germs have been made by Celli, who fed flies with the sputum from phthisical patients, also with pure cultivations of the typhoid bacillus, of anthrax, and other organisms. The particular microbes experimented with were afterwards demonstrated in the excreta of these flies, partly by microscopic examination and partly by direct inoculation into animals. The latter method was especially successful in the case of the anthrax and tubercle bacilli. A paper which has just appeared by Sawtschenko in the *Centralblatt für Bakteriologie*, vol. xii. p. 893 ("Die Beziehung der Fliegen zur Verbreitung der Cholera") contains an account of some experiments which the author has made on the fate of cholera bacilli when introduced into flies. The flies used in these investigations were (1) the common small house-fly and (2) a much larger variety, which, from the description given, would seem to answer to our so-called "blue-bottle fly." It was further marked by its rapid flight, its rare occurrence within doors, by feeding on all manner of decaying substances, besides being frequently found on articles of food of all kinds. These flies were placed in shallow dishes containing a few drops of broth infected with cholera bacilli, after which they were removed and fed on raw meat or sterile broth. In some cases the excrements of cholera patients were substituted for the cholera cultures. It would appear very difficult to keep flies alive in captivity, for the healthy as well as those experimented upon died in nearly all cases after twenty-four hours; in only very few instances was it possible to preserve them four days. Not only were the excreta of the flies carefully examined for cholera bacilli, but in

many cases the whole contents of the abdominal cavity were removed with all the proper antiseptic precautions, and inoculated into culture tubes. This latter practice was adopted in order to satisfactorily dispose of all suggestion of the presence of cholera germs in the excreta being due to their accidental contamination from the feet of the flies themselves. In all cases cholera bacilli were found, both in the alimentary tract and in the flies' excreta. Moreover, guinea pigs inoculated with cultivations of cholera microbes obtained from the former died quite as rapidly as when inoculated with ordinary cholera cultures, thus showing that their virulence had not been impaired through residence in the fly's body. In the intestinal tract of those flies fed with cholera excreta, not only were cholera bacilli found, but also other organisms resembling the vibrio Metschnikowi Gamaleia, and which on inoculation into guinea-pigs and pigeons killed them in twenty-four hours. Similar results were obtained when the vibrio was separated out directly from the cholera excreta and inoculated into these animals. Thus in this case also the virulence of the organism had undergone no abatement during its sojourn in the fly's alimentary tract, thus fully confirming similar results with other organisms obtained by Celli. Sometimes enormous numbers of cholera bacilli were found in the alimentary tract of flies after seventy-two hours, in spite of their having been fed after the first infection with nothing but sterile broth, with the object, if possible, of washing out the bacilli. Sawtschenko makes the alarming suggestion that the bacilli may very possibly be able, under suitable conditions of temperature and nourishment, to multiply within the bodies of flies, in which case the latter must not only be regarded as dangerous carriers of infection, but as a hot-bed for the preservation and further multiplication of cholera bacilli.

SCIENTIFIC SERIALS.

American Journal of Science, March. The specific heat of liquid ammonia, by C. Ludeking and J. E. Starr. The liquid ammonia used in the experiments was found to contain 0.3 per cent. of moisture, and on spontaneous evaporation to leave only a trace of residue. The specific heat was measured by Regnault's method, the liquid being enclosed in a steel tube of 16.122 cc. capacity, stoppered by a steel screw. The mean value for the specific heat deduced from two series of experiments was 0.8857. —A short cycle in weather, by James P. Hall. If a diagram is drawn exhibiting the changes of daily mean temperature in New York city for a few months it will be discovered that these fluctuations occur every three or four days, on an average, but that some have much greater amplitude than others. In the course of four weeks, perhaps, there will be only two or three conspicuous rises and falls. Upon further scrutiny there will be observed a tendency in these more prominent features of the curve to repeat themselves at intervals of about 27 days. That these and kindred oscillations in New York city are, in the main, representative of temperature changes over the greater part of the United States becomes evident on comparing temperature curves taken at Utah, St. Paul, St. Louis, and New York respectively. A conspicuous rise of temperature at New York is apt to be a day or two behind that at St. Louis, fully two days behind St. Paul, and sometimes nearly a week behind Utah. Mr. Hall attempts to find a relation between this 27-day period and the sun's rotation, which takes place in about the same time. —Kilauea in August, 1892, by Frank S. Dodge. The chief object of interest on the floor of Kilauea was the lava lake of Halema'uma'u, whose surface was found to measure 12.1 acres, which is much larger than any lake in recent years. The lake is nearly circular in form, its longest diameter being 860 feet, and the shortest 800 feet. The lava was about three feet below the rim on an average. Frequent breaks occurred in the rim, from which large flows took place, in some cases covering several acres of the floor. One large flow on the night of August 25th covered about one-third of the floor, and raised its level from one to four feet. The lake was at times very active, with fountains playing over its surface in every direction, as many as fifteen being counted at one time by a careful observer. Small fountains were always to be seen in some locality, and the whole surface was marked by long irregular seams always in motion. —Also papers by Messrs. Chamberlin, Darton, Upham, and Winslow, and the Address delivered

before the American Metrological Society, December 30, 1892, by the President, Dr. B. A. Gould.

Bulletin de l'Académie Royale de Belgique, No. 1, 1893.—On Poisson's law of large numbers, by P. Mansion.—On the influence of time upon the mode of formation of the meniscus at the temperature of transformation, by P. de Heen. If a sealed glass tube is partly filled with carbonic acid in the liquid state, and then heated slightly above the critical temperature, the meniscus forming the surface of separation gradually disappears until all the liquid is converted into vapour. But for some time after this has taken place the density of the substance above the surface of separation is less than that below, as may be seen by the appearance of a generating line. If the tube is withdrawn from the water bath at 33° , the formation of a small cloud is observed in the region where the meniscus disappeared, and the latter is gradually reproduced in the same place. The phenomenon is not observed when the tube is inverted, or kept at 33° for 24 hours, thus allowing the two constituents to mix by diffusion.—Two experimental verifications relating to crystalline refraction by J. Verschaffelt.—Crystallographic note on the axinite of Quenast, by A. Franck.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, February 24.—Prof. A. W. Rücker, F.R.S., President, in the chair.—Mr. Everett, junr., read a paper on a new and handy focometer, by Prof. J. D. Everett, F.R.S., and exhibited the instrument described. The focometer is constructed on the principle of the "Lazy tongs," and so arranged that the distance between the object and screen can be varied whilst the lens is automatically kept midway between the two. This gives sharpest definition and the simplest calculation. The lazy tongs has eight cells, formed by eighteen bars $13'' \times \frac{3}{4}'' \times \frac{1}{4}''$, and is capable of being extended to about eight feet, or closed up to about one foot. Brass pins about $\frac{1}{4}''$ diameter and one and half inches long project upward from each joint in the middle row, and serve as supports for clips carrying the lens, object, and screen. The instrument can be used for any lens whose focal length lies between twenty-four inches and one inch or less. Details respecting the most appropriate objects and screens, and practical hints about the working of the instrument are given in the paper. The question of what accuracy is obtainable is also briefly discussed.—Mr. A. Hilger thought the instrument was too flexible to be used for accurate work.—Mr. Blakesley suggested that by using a plane mirror close behind the lens the light would be reflected back, and the length of the focometer could be reduced by one-half.—The President thought Prof. Everett never intended the instrument to compete, as regards accuracy, with the elaborate and expensive apparatus now used, but nevertheless the focometer was a very valuable one, especially for students' work, and was particularly well adapted to impress upon them the facts relating to conjugate foci.—A paper on a hydrodynamical proof of the equations of motion of a perforated solid, with applications to the motion of a fine framework in circulating liquids, by G. H. Bryan, M.A., was read by Dr. C. V. Burton. The object of the paper, which is a mathematical one, is to show how the equations may be deduced directly from the pressure-equation of hydrodynamics, without having recourse to the laborious method of "ignorance" of co-ordinates. The results are applied to determine the motion of a light framework of wires. When the framework has a single aperture it is shown that no force produces motion in its own direction, and no couple produces rotation about its own axis. In the case of a fine massless circular ring the direction of whose axis is taken as the axis of x , a constant force along the axis of y produces uniform rotation about the axis of z , and a constant couple about the axis of y produces uniform translation along the axis of z . In conclusion the author states that the results might be made to furnish mechanical explanations of certain physical phenomena. The President said the author had done good service by attacking the difficult problem by elementary methods.—Dr. C. V. Burton made a communication on plane and spherical sound-waves of finite amplitude. The first part of the paper refers to plane waves. This subject had been considered by Riemann, but Lord Rayleigh had criticised that part of Riemann's work, where it is held that a state of motion is

possible in which the fluid is divided into two parts by a surface of discontinuity propagating itself with constant velocity, all the fluid on one side of the surface of discontinuity being in one uniform condition as to density and velocity, and on the other side a second uniform condition in the same respects. After quoting Lord Rayleigh's criticisms the author shows that the same objection applies when the velocity and density on either side of the surface may vary continuously in the direction of propagation, and the velocity of propagation of the surface of discontinuity is also allowed to vary. In each case the assumed motion violates the condition of energy, and can only exist under that special law of pressure for which progressive waves are of accurately permanent type. Inquiry is then made as to what becomes of waves of finite amplitude after discontinuity sets in (which condition must always occur with plane waves), in the course of which it is pointed out that the front of an air disturbance produced by a moving source which starts impulsively, travels faster than the source, even if the velocity of the source exceeds that of feeble sounds. A mechanical analogy suggests that a dissipative production of heat takes place when discontinuity occurs. In all cases Riemann had assumed that the pressure is a function of density only according to the isothermal or adiabatic law, and thus failed to take account of any heat which may be dissipatively produced. Part II. of the paper deals with spherical waves, and contains a mathematical investigation into the conditions under which the motion remains continuous or becomes discontinuous. The criterion is found in the finitude or infinitude of a certain integral. It is shown that if viscosity be neglected, then under any practically possible law of pressure the motion in spherical sound waves always becomes discontinuous. For waves diverging in four dimensions some cases occur in which the motion remains continuous. The general question of spherical sound waves of finite amplitude is then treated of, and the paper concludes with a method of finding the differential equation of an infinitesimal spherical disturbance which is superposed on a purely radial steady motion. Prof. A. S. Herschel inquired whether the nature of the solution for plane waves of finite amplitude was similar to that for ordinary waves-motion? In the latter case everything depended on the instantaneous impulses, for these alone determined the nature of the wave. The President said Mr. Boys' experiments on flying bullets might have some bearing on Dr. Burton's paper. If the conclusions there stated were correct, then the velocity of the air in front of a bullet should be greater than that of the bullet, even if the latter was travelling faster than ordinary sound waves. He now asked Mr. Boys if his photographs gave any evidence of this. Mr. Boys said the fact that the photographs showed disturbances in front of the bullet proved that the disturbance travelled faster. In one case where a large bullet was moving at a velocity rather greater than that of ordinary sound in the medium, the front of the disturbance was about half an inch in advance of the bullet. In another instance where the bullet was smaller and the velocity greater, the distance which the disturbance was in advance of the bullet was somewhat less. In all cases, even when the velocity of the bullet was four times that of sound, the character of the effects remained the same. Dr. Burton replied to the points raised.

March 10.—Prof. A. W. Rücker, F.R.S., President, in the chair.—Dr. C. V. Burton read a paper on the applicability of Lagrange's equations of motion to a general class of problems, with special reference to the motion of a perforated solid in a liquid. The paper shows that to apply Lagrange's equations it is not always necessary that the configuration of the system should be completely determined by the co-ordinates, but that under certain conditions one need not consider whether the whole configuration is determined by the nature of the known co-ordinates, nor inquire what is the nature of the ignored co-ordinates. The result, which is arrived at by the aid of the "principle of least action," and the investigation given in Thomson and Tait's "Natural Philosophy," second edition, part i. § 327, is expressed by the following proposition:—If the kinetic energy of a material system can be expressed as a homogeneous quadratic function of certain generalised velocities $\psi, \phi, \dots$ only, the co-efficients being functions of $\psi, \phi, \dots$ only, and if this remains always true so long as the only forces and impulses acting are of types corresponding to $\psi, \phi, \dots$, the equations of motion for the co-ordinates $\psi, \phi, \dots$ may be written down from this expression for the energy in accord-